REMARKS

A Request For A Three Month Extension Of Time is submitted herewith, along with the required extension fee of $490.00.

Claims 1, 3-12, 14-16, 18-19, and 22-26 remain in this application. Claims 2, 13, 17, 20 and 21 have been canceled. Claims 22-26 have been added.

Claim 1 has been amended to incorporate the limitations of dependent Claim 2; Claim 2 has been canceled. Claim 12 has been amended to incorporate the limitations of dependent Claim 13 and Claim 19 has been amended to incorporate the limitations of dependent Claims 20 and 21. Claim 17 has been rewritten in independent form as Claim 22. Claims 23-26 have been added incorporating the limitation of the locking of the screw set pin to the bolt.

The examiner has rejected Claims 1, 5-9, 12, 14-16 and 19 under 35 U.S.C. 102(d) as anticipated by Liljeberg 3,042,094. Claims 2-4, 10, 11,13, 18, 20 and 21 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Liljeberg in view of Weller 3,618,135. Applicant appreciatively notes the allowability of Claim 17 if written in independent form; accordingly applicant has canceled Claim 17 and rewritten same as independent Claim 22 incorporating all the limitations of the original Claim 17 and the base claim and intervening claims.

The Liljeberg patent is primarily directed to the maintenance of tensile strength of a main screw by utilizing an expander as a second bolt or screw to add tensile strength to that of the main screw (column 1, lines 35 et seq.). However, Liljeberg apparently abandoned that concept when adopting the construction of Figure 6. It is important to note that Liljeberg requires a tapered end portion 68 that mates against a corresponding surface 65. When these two surfaces are forced into contact, the pin contact with the internal tapered surface of the bolt occurs only at the root or base of the frusto-conical internal surface. To illustrate this physical situation, the enclosed sketch (Exhibit 1) is provided wherein Figure A represents the present application Figure 6 and Figure B is a representation of Liljeberg having its frusto-conical surfaces advanced for locking purposes. In each case, the set screw pin has been advanced into the bore of the bolt to make contact with the corresponding interior surface of the bolt and been advanced .025 inches. By reference to Figure A attached hereto it may be seen that the present application presents a moment arm or force radius of .310 inches to thus create significant force for locking the bolt in place. In contrast, since only the root of the frusto-conical taper of the pin of Liljeberg can apply force if the pin is moved into the bolt, the available moment arm or radius is only .083 inches. With this small moment arm, to achieve anywhere near the locking force provided by the present application, the torque necessary to apply to Liljeberg would be destructive and clearly would cause failure of the set screw pin threads and cause galling. Thus, the concepts involved in the two locking systems are unrelated; there is no suggestion of Liljeberg to attempt to utilize any means for preventing such galling or achieving a greater moment arm in the application of force to spread the respective bolt.

While Liljeberg's set screw central portion is threadless, it is important to recognize that Liljeberg depends on the meeting surfaces of the internal taper of the bolt bore and the taper of the distal portion of the set screw. It is also interesting to note that Liljeberg emphasizes the relationship of these surfaces and specially refers to the fact that the "drawings which are drawn substantially to scale throughout the several views . . . (column 2, lines 13 et seq., and again emphasizes this fact when discussing Figure 6). Note Liljeberg states "a male expander 66 is provided having an elongated cylindrical shank 67 of the same diameter as the bore 63 and a tapered end portion 68 of a size to fit against the surface 65 as shown in Figure 6 which is drawn to scale" (column 5, lines 32 et seq.) and again, Liljeberg in that same paragraph has emphasized this relationship by referring to the fact that the drawings are to scale "the drawings have been drawn to scale so that such features will be disclosed clearly by the drawings alone" (column 5, lines 45 et seq.).

Thus, Liljeberg uses a tapered pin that matches the tapered bore in the bolt. The apparent concept is that the tapered pin will provide a uniform radial force along the taper pin to expand the bolt threads into the nut. The resisting force to prevent the bolt from self-loosening is the friction between the pin end bolt along the taper. Insofar as the tapered area of the pin is in perfect contact with the tapered bore surface in the bolt, the locking effect is operable. In realty, and referring to the description in column 5, lines 17-50 and column 6, lines 1-12, Liljeberg states "the gradual taper of the surface 65 permits expending the metal against all of the threads of the nut 56 so as to effectively resist rotation of the nut . . .". Figure 6 of the patent shows that the taper on the pin engages the tapered bore in the bolt within two threads of the narrow slit in

the bolt (reference 61 in Figure 6). This means that the force to spread the bolt tip is applied at essentially its most rigid position. As the pin is tightened, the taper on the bolt expands such that the contact area between the pin and the bolt actually decreases in the limit to only a line contact at the root of the taper as illustrated in the attached sketch Figure B. Thus, there is a likelihood of galling at the root of the taper pin.

The Weller patent is directed to an electrical component used in UHF and microwave frequencies and may be used as a variable susceptance in wave guide applications. In view of the intended use of the Weller structure, it obviously would not be constructed with the problems presented by high torque or high tensile force applications wherein high forces and galling are present. However, assuming arguendo that Weller could be used in a high tensile strength application, the utilization by Weller of threads 18 extending substantially throughout the length of his set screw in contact with mating threads of his bushing element describes a concept that fails to recognize teach or suggest the utilization of force application for locking purposes without creating forces that will destroy or gall mating parts. For convenience, applicant has attached hereto Figure C (Exhibit 2) which is an enlarged view of Figure 5 of the Weller patent. Again, assuming that Weller could be utilized in high force high tensile strength situations, the continuous engagement of the threads throughout the length of the set pin would render the system unworkable and self-destructing. For example, as shown in Figure C, the set pin 10 is advanced into the bore to begin to spread the split fingers at the end of his tooling element 12 as shown by the broken lines 14. As the pin is moved further into the tooling element, and the split finger is beginning to move outwardly away from the pin, the area of the threads that are

engaged between the tooling element and the pin decreases. Again, it must be remembered that the environment is a high tensile force environment; the reduction in engaged thread area correspondingly increases the forces on the threads that remain engaged. As the fingers spread apart and the threads beneath the fingers become disengaged, galling occurs and the device's usefulness has been destroyed.

It is not seen how one of ordinary skill in the art would refer to an invention relating to a variable electrical capacitor or susceptive element. This product is not intended for strength and is purely electrical in nature. It is not faced with the force/vibration obstacles to which the present invention is directed (e.g. automotive manifold bolts and the like). While the Liljeberg reference is indeed concerned with the decrease in the tensile strength of the bolt resulting from the removal of metal from the internal bore, it is unlikely that a person of ordinary skill in the art would refer to an electrical capacitor design (Weller) when strength of the bolt is of substantial significance while electrical capacitor of this strength is of little or no consequence.

The contact point between the tapered end of the set screw in Weller remains constant as a set screw is screwed in. As the set screw is screwed in, the internal bolt threads engaging the set screw threads towards the distal end becomes spread apart and start to disengage - - - this creates binding through increased frictional force on the remaining engaged threads. This increase force is totally unacceptable and creates galling which can result in extreme forces being required to further the set screw into the bore or make it impossible to remove the set screw. These considerations are most important in Weller in view of the fact that the product

described is necessarily light and fragile and considerations of strength are usually not important in electrical component construction. There is no suggestion or teaching concerning the removal of the set screw threads, either in Weller or their removal from Weller before combining with Liljeberg.

Applicant's invention provides a means for locking the screw set pin to the bolt in addition to locking the bolt in a bolt receiving hole. The screw set pin is advanced in the bore of the bolt such that the tapered end section of the pin shaft expands the bolt fingers defined by the slits provided in the fingers. As the fingers elastically deform a differential radius of the internal tapered bore versus the radius of the tapered end of the screw set pin creates localized high pressure points of contact between the internal tapered bore and the tapered end of the screw set pin. The result of this action creates a locking force that securely locks the screw set pin in its torqued position within the bolt. Thus, the bolt assembly is locked in two ways: the bolt is securely locked within a bolt receiving hole by the expansion of the bolt fingers firmly engaging the threads of the bolt receiving hole, and secondly, the screw set pin is firmly locked to the bolt. Thus, vibration, thermal expansion and contraction, and other bolt-loosening forces can not unlock the bolt. The prior art fails to show or teach any screw set pin locking feature; this element is ignored by the prior art.

Applicant's invention provides a self-locking bolt assembly that is distinguishable from the teachings and suggestions of the prior art. The prior art fails to recognize the importance of the taper angles of the pin shaft and the bore combined with the threadless portion of the screw

set pin and the manner in which the forces applied through mating threads at the proximal end of the set screw pin and bore. Further, the prior art has failed to recognize, disclose or teach the utilization on differential radius means for locking the screw set pin of the self-locking bolt assembly into a threaded bolt receiving hole.

In view of the above arguments and amendments, it is respectfully submitted that the present application is in condition for allowance.

Respectfully submitted,

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